FAUNAL COMPOSITION OF SMALLER MOTHS (MICROLEPIDOPTERA) IN LOWLAND TROPICAL RAINFOREST, SARAWAK

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ABSTRACT

A total of 222 individuals of the microlepidoptera representing 92 species were collected using an illuminated vertical light sheet from secondary lowland forest at Matang Wildlife Centre, Kota Samarahan, and Sri Aman, Sarawak. Nine families of these smaller moths were represented, with Pyralidae as the most abundant and diverse family. The three commonest species were *Cnaphalocrocis patnalis* Bradley, *Nacoleia charesalis* Walker and *Picrostomastis inductalis* Walker. These were represented by 12 individuals each. Tineidae and Pterophoridae represented the least diverse families with a single species and individual collected each. The faunal composition is further discussed and compared to other available studies on moths of Borneo.

Key words: Faunal composition, lowland tropical forest and light traps.

ABSTRAK

Sebanyak 222 individu daripada 92 spesies Mikrolepidoptera disampel menggunakan perangkap cahaya aktif dan perangkap cahaya pasif kawasan hutan di Pusat Perlindungan Hidupan Liar Kota Samarahan, dan Sri Aman, Sarawak. Sembilan famili mikrolepidoptera diwakili oleh Pyralidae sebagai famili yang paling melimpah. Tiga spesies paling biasa diperolehi dan ini ialah Cnaphalocrocis patnalis Bradley, Nacoleia charesalis Walker dan Picrostomastis inductalis Walker, masing-masing dengan 12 individu setiap satu. Tineidae dan Pterophoridae adalah famili yang paling kurang dijumpai dengan satu spesies dan individu mewakili setiap satu. Komposisi fauna selanjutnya dibincangkan dan dibanding dengan kajian lain yang telah dibuat ke atas kupu-kupu di Borneo sebelum ini.

Kata kunci: Komposisi fauna, hutan tropika tanah rendah dan perangkap cahaya.

INTRODUCTION

Moths and butterflies belong to the order Lepidoptera (Holloway, 1976; Barlow, 1982). This order can be further subdivided into two groups, the Macrolepidoptera, or larger moths and butterflies, and the Microlepidoptera, or smaller moths (Romoser *et. al.,* 1998).

The Microlepidoptera include all of the very small Lepidoptera as well as all of the 'primitive' families. They usually have a wingspan of 20 mm or less. According to Romoser *et. al.* (1998), the microlepidoptera are wasp-like in appearance with extensive wing areas devoid of scales. Forewings are long and narrow, and adults of most species are diurnal. Larvae bore into roots, stems and trunks.

More than one-quarter of the world's 165,000 named Lepidoptera species are Microlepidoptera. Forty-two families of these smaller moths have been recorded from South East Asia and 90% of these species belong to four superfamilies– Tineoidea, Gelechioidea, Tortricoidea and Pyraloidea (Robinson, *et al.*, 1994). Pyralidae is the largest microlepidoptera family, and its members are widespread and common (Robinson, *et al.*, 1994; Robinson, *et al.*, 1993).

Many microlepidoptera have been identified as local pests. In agriculture, losses due to insect pests have been estimated to reach 44% (Khoo *et. al.*, 1991). However, they are also essential agents for plant pollination (Price, 1984). Among the microlepidopterans that have been identified as important local pests are the rice stem borer, *Chilo suppressalis* (Lepidoptera: Pyralidae), rice leaf-folder and *Cnaphalocrocis medinalis* (Lepidoptera: Pyralidae) (Speight, et al., 1999). The pyralid, *Chilo sacchariphagus* is one of the common borer species infesting sugar cane and can be considered as a major pest. Another common pest is the gracilarid, *Conopomorpha cramerella*, which is also known as the cocoa pod borer (Azhar & Long, 1991; Singh, 1992). This is currently the most important pest of cocoa wherever it occurs. Native populations of this species, feeding on rambutan and related sapindaceous fruits and *nam-nam*, can occasionally cause damage (Khoo, *et. al.*, 1991).

Besides the above-mentioned four species, another microlepidoptera that attain major pest status is the pyralid diamondback moth, *Plutella xylostella*. It became a major concern after 1957, and has continued to this day to be the subject of many researches. The diamondback moth is the most important pest of crucifers in Malaysia and indeed in most tropical countries where it has been introduced (Khoo, *et. al.*, 1991; Kmec, *et. al.*, 1997; Rahman, 1992). A number of the microlepidoptera are also pests of oil palms. These include the pyschid; *Mahasena corbetti*, *Metisa plana* and *Pteroma pendula* which are common species that attack mature oil palms (Norman, *et. al.,* 1994; Oii, 1994; Ibrahim, 1988).

Apart from being pests, a number of the microlepidopteran species are important as predators on scale-insects (Coccoidea) while some Tineidae are predators in ants' nests (Robinson, *et al.*, 1994). Moths could also be potentially used as a bioindicator to indicate the potential loss of diversity in general, for both plants and animals (Holloway & Barlow, 1991).

To date, not many studies have been done to document the smaller moth composition in the tropics. The ratio of the larger moths to the smaller moths will rise

substantially as our knowledge of this group improves. Their existence in our ecology brings deep meaning to entomologists.

The objective of this study was to investigate the faunal composition and diversity of the smaller moths in secondary forests in Sarawak. It is hoped that this study will serve as the basis of further studies on the microlepidoptera of Sarawak.

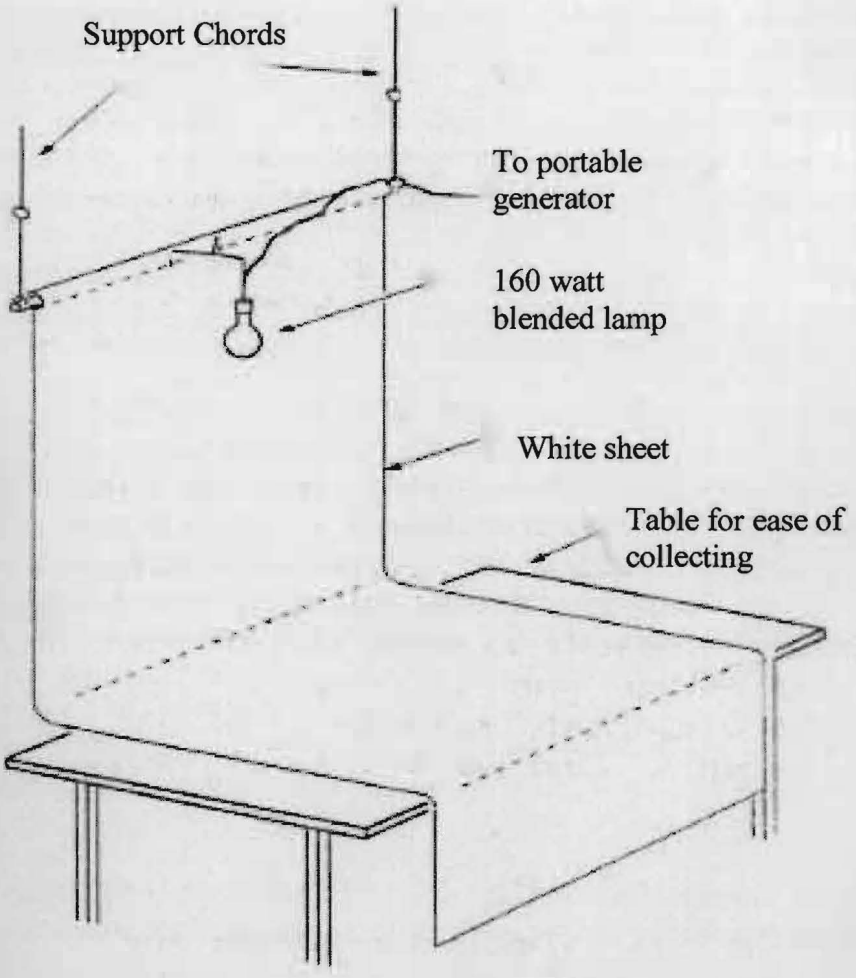
MATERIALS AND METHODS

1.1 Collection of specimens

Specimen collecting was done using an illuminated vertical light sheet. The light source consisted of one 160-watt mercury vapor lamp. Collecting started at 1900hrs and lasted until 22hrs.

This collecting method attracted the microlepidoptera at night to an illuminated sheet. Once microlepidoptera alighted on the illuminated sheet, it would be collected into an individual corked glass tubes.

Microlepidoptera have long wing fringes; any attempt at relaxing specimens with folded wing in a humidity chamber results in dampness matting the fringes and moisture holding the wings together (Robinson, et al., 1994). Thus, all died microlepidoptera had to be set immediately. Living microlepidoptera inside cork glass tube killed in a killing jar with a layer of *plaster of Paris* (recharge with ethyl acetate).



1.2 Pinning and spreading

Pinning and spreading was done in the field and laboratory, using a magnifying glass and stainless minuten pins. The pinning and spreading of microlepidoptera need patience and care. This procedure follows the international standard of pinning and spreading microlepidoptera as stated by Robinson, et al. (1994).

In pinning the specimen, the pins have to pass downwards and backwards (about 10-20° from the vertical) through the mesothorax on the centre-line of the body. Two-thirds of the pin should be inserted below the specimen and one-third above. The specimen was later pinned into plastazote. The wings were then spread using a mounted needle and held in position by friction against plastazote.

1.3 Labeling and preservation

Specimens were left at room temperature to dry. Each specimen was labeled immediately with place, date of capture and name of collector. Identification follows *A Field Guide to The Smaller Moths of South East Asia* by Robinson, et. al. (1994).

RESULTS & DISCUSSION

A total of 222 individuals of microlepidoptera comprising of 92 species were collected in this study. These are distributed among 9 families, namely Gelechiidae (Table 1), Lecithoceridae, Psychidae, Pterophoridae, Pyralidae, Thyrididae, Tineidae, Tortricidae and Yponomeutidae. According to Robinson *et. al.,* (1994). 42 families of microlepidoptera are recorded from Southeast Asia. Out of these, routinely, only 10 to 15 families are found by naturalists on the regular basis (Robinson et. al., 1994).

Table 1 highlights the family composition of the microlepidoptera collected from this study. Overall, Pyralidae represented the most diverse family. This is in accordance with Abang & Karim (1998) who also found Pyralidae as the most diverse family of moths from a secondary peat swamp forest in Kota Samarahan.

In this study, 75.97% or 163 individuals out of the total of 222 smaller moths were Pyralidae (Table 4). 18 individuals out of 163 are unidentified. Being a widely distributed family, Pyralidae is apparently rich in species and probably represents the most common microlepidoptera found in all areas, lowland and montane (Robinson *et. al.*, 1994). Family Pyralidae consist of 12-collected subfamily. They are Crambinae, Endotrichinae, Epipaschiinae, Galleriinae, Hycitinae, Nymphulinae, Odontiinae, Peoriinae, Phycitinae, Pyraustinae, Schoenobiinae and Wurthiinae. They represented by 68.48% number of species and 75.97% number of individuals. Among them, (Table 2) six most frequent species are *Gauna mediolineata* from subfamily Endotrichinae, *Cnaphalocrocis patnalis, Crypsiptya colesalis, Gadessa nilusalis, Hyalobathra illectalis* and *Nacoleia charesalis* from subfamily Pyraustinae. *Gauna mediolineata* ranges widely from North East India, Thailand, and West Malaysia to Sabah. *Cnaphalocrocis patnalis,* It does widely distribute from Sri Lanka, West Malaysia, Sabah, Sarawak, Java, Brunei and Philippines. Abang & Karim (1998) also listed *C. patnalis* as one of the commonest species in their survey. *C. patnalis* is common pest for *Oryza sativa* (rice) (Khoo *et. al.,* 1991; Robinson *et. al.* 1994). Availability of food sources from nearby agricultural plots obviously contributes to this (Abang & Karim, 1998). Apparently paddy fields are found in the vicinity of the collecting sites in this study. *C. colesalis* ranges from India, Bhutan, Japan, Burma, West Malaysia, Singapore, Java, Sarawak and Philippines, widely distributed from lowland to montane area. It consists of three species (Robinson *et. al.*, 1994). *H. illectalis* ranges from India, Sri Lanka, Taiwan, Burma, West Malaysia, Singapore, Sabah, Philippines, New Guinea, Australia and Fiji, which distributed widely from lowland to montane area. In South East Asia, 5+ species of *Hyalobathra* can be found and *H. illectalis* is the most common (Robinson *et. al.*, 1994). *N. charesalis* ranges from Seychelles, Sri Lanka, West Malaysia and Sabah, in lowland area. They always confused with *Lamprosema* and consequently, its true range and constituent species have not yet been clarified.

In the superfamily Gelechioidea, only two species were collected and these were from the family Oecophoridae. Among these, *Synclara sp.* was the most frequent species. *Synclara* is a widely distributed ranging, from China and India to New Guinea. It consists of six named species, most of which occur in South East Asia. *Synchlara sp.* larvae have been reported to feed on tea and attack the bark, causing great damage to the host-plant (Robinson *et. al.*, 1994).

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In the Lecithoceridae, only one species, *Thubana bisignatella* was collected. As stated in table 4, this family represented by 1.09% numbers of species and 1.80% numbers of individuals. Its distribution ranges from Brunei and Sarawak. *Thubana* currently contains 21 species from the Oriental region of which seven occur in South East Asia (Robinson *et. al.*, 1994).

Only five species were recorded in the family Psychidae, and three of these species could not be unidentified currently. Two species are *Kophene cuprea* and *Degia sp. Degia sp.* is found in lowland area of Thailand, West Malaysia, Brunei, Sabah and Sarawak (Robinson *et. al.*, 1994). Both species are common pests. *Kophene cuprea* is pest for rubber and tea and *Degia sp.* or bagworm is pest for coffee (Azhar & Long, 1991; Ibrahim, 1988; Kmec & Weiss, 1997; Norman *et. al.*, 1995 & Ooi, 1988).

Like Lecithoceridae, only one species of Pterophoridae was collected. *Diacrotricha sp.* has divided wings and ranges widely in all area, from India, Sri Lanka, Taiwan, West Malaysia, Sabah and Brunei (Robinson *et. al.*, 1994).

In the family Thyrididae, 24 individuals within 12 species had been collected. Four of these cannot be identified. Among them, the most frequent species is *Picrostomastis inductalis.* It ranges from Burma, Thailand, West Malaysia, Burma, Sumatra, Java, Brunei, Sabah, Sarawak, Moluccas, Seram, Timor and New Guinea, from lowland to montane area. It consists of 11+ species in which six occur in South East Asia (Robinson *et. al.*, 1994).

From family Tineidae was also represented by one species. *Opagana sp.* ranges widely from Sri Lanka to West Malaysia, in lowland and montane area. *Opagana sp.* is common throughout South East Asia and their larvae probably grazed fungal mycelia.

The family Tortricidae consists of two subfamilies in which six species had been collected, that are 6.52% of the number of species. *Bactra sp.* From the subfamily Olehtreutinae was represented by only one individual. It ranges widely in lowland areas. Larvae recorded feeds within a stem of *Cyperus rotundus* (Cyperaceae) (Robinson *et. al.*, 1994). From the subfamily Tortricinae five species were collected with seven individuals. Among this species, *Meridemis* species was the most frequent with three individuals collected. This species ranges widely from Taiwan, Nepal, Thailand, West Malaysia, Sumatra, Java, Bali and Sulawesi in lowland and montane areas (Robinson *et. al.*, 1994).

Similar to Tineidae, Yponomeutidae was also represented by only one species with one individual collected. It is the famous diamondback moth, which is *Plutella xylostella.* It has a pantropical distribution, in South East Asia from all territories. *P. xylostella* is a serious pest of crucifers (Azhar & Long, 1991; Ibrahim, 1988; Kmec & Weiss, 1997; Norman *et. al.*, 1995 & Ooi, 1988). There are 40+ species of *Plutella* worldwide, but none apart from *xylostella* has been recorded from South East Asia (Robinson *et. al.*, 1994).

Overall, 58.7% (Table 4) or 54 species out of the 92 species (Table 3) of the smaller moths sampled were represented by singletons or one individual each. This indicated that many of the smaller moths could be considered as uncommonly encountered. Pterophoridae, Yponomeutidae and Tineidae were found to be poorly

represented. Only a single species and individual each from these families were encountered throughout this study.

(Table 1) Twenty-three of the smaller moth families were not encountered at all in this study. These were Hepialidae, Nepticulidae, Opostegidae, Heliozelidae, Adelidae, Eriocottidae, Roeslerstammiidae, Glyphiterigidae, Agonoxenidae, Ethmiidae, Blastobasidae, Cosmopterigidae, Gelechiidae, Scythrididae, Sesiidae, Choreutidae, Immidae, Copromorphidae, Carposinidae, Epermeniidae, Alucitidae, Tineodidae and Hyblaeidae. Moths from these families (excluding Blastobasidae, Immidae, Copromorphidae and Hyblaeidae) are either day-fliers or predominantly found in montane areas. Blastobasidae, Immidae, Copromorphidae and Hyblaeidae, however, are commonly found in lowland areas (Robinson *et. al.*, 1994). Their absence in this study could be probably due to the time of sampling. According to Barlow & Woiwood (1989), some moths only appear at certain times of the years. Therefore, sampling time also could account for the absence and presence of some moths in the samples.

Table 1: The number of individuals of microlepidoptera collected in lowland tropical forest of Sarawak.

Family	UNIMAS, Kota Samarahan.	Matang Wildlife Centre, Matang.	Kampung Hilir, Sri Aman.
Hepialidae	0	0	0
Nepticulidae	0	0	0
Opostegidae	0	0	0
Heliozelidae	0	0	0
Adelidae	0	0	0
Tineidae	1	0	0
Eriocottidae	0	0	0
Psychidae	7	2	0
Roeslerstammiidae	0	0	0
Gracillariidae	0	0	0
Yponomeutidae	0	0	1
Glyphipterigidae	0	0	0
Oecophoridae	7	4	0
Batrachedridae	0	0	0
Agonoxenidae	0	0	0
Ethmiidae	0	0	0
Blastobasidae	0	0	0
Cosmopterigidae	0	0	0
Gelechiidae	0	0	0
Lecithoceridae	3	1	0
Scythrididae	0	0	0
Tortricidae	3	4	1
Sesiidae	0	0	0
Choreutidae	0	0	0
Immidae	0	0	0
Copromorphidae	0	0	0
Carposinidae	0	0	0
Epermeniidae	0	0	0
Alucitidae	0	0	0
Tineodidae	0	0	0
Pterophoridae	1	0	0
Hyblaeidae	0	0	0
Thyrididae	2	22	0
Pyralidae	91	55	17
Total	115	88	19

Total of individuals: 222 individuals
Total of family: 34 families
Number of family collected: 9 families

Table 2: The number of individuals of microlepidoptera collected in lowland tropical forest of Sarawak.

Family	Species	No. of individuals
Gelechioidea		
Oecophoridae	*Synchalara sp.*	10
	Metathrinca loranthivora Meyrick	1
Lecithoceridae	*Thubana bisignatella* Walker	4
Psychidae	*Kophene cuprea* Moore	1
	Degia sp.	1
	Psy1	1
	Psy2	1
	Psy3	5
Pterophoridae	*Diacrotricha sp.*	1
Pyralidae	*Calamotropha atkinsoni* Zeller	3
Crambinae	*Endotricha denticostalis* Hampson	1
Endotrichinae	*Gauna mediolineata* Hampson	6
	Coenodomus anomala Aurivillius	2
Epipaschiinae	*Achroia sp.*	1
Galleriinae	*Ertzica sp.*	1
	Tirathaba ruptilinae Walker	1
	Ceroprepes walterzeissi Roesler	2
Hycitinae	*Eristena sp.*	1
Nymphulinae	*Parapoynx stagnalis* Zeller	3
	Clupeosoma sp.	1
Odontiinae	*Pseudonoorda nigropunctalis* Hampson	2
	Pseudonoorda sp.	2
	Rhinaphe nigricostalis Walker	1
Peoriinae	*Assara albicostalis* Walker	2
Phycitinae	*Etiella sp.*	1
	Hypargyria sp.	1
	Succadana sp	3
	Pyr 20	1
	Aetholix borneensis Hampson	2
Pyraustinae	*Aetholix sp.*	5
	Ceroprepes sp.	1
	Cnaphalocrocis medinalis Guenée	1
	Cnaphalocrocis patnalis Bradley	12
	Conogethes sp.	3
	Crypsiptya coclesalis Walker	6
	Gadessa nilusalis Walker	8
	Gadessa sp.	1
	Glyphodes bivitralis Guenée	1
	Heterocnephes lymphatalis Swinhoe	4
	Hyalobathra illectalis Walker	11
	Hymenia perspectalis Hübner	3
	Hymenia sp.	1
	Metoeca foedalis Guenée	5
	Nacoleia charesalis Walker	12
	Omiodes diemenalis Guenée	1

	Omiodes sp.	3
	Pachynoa sp.	1
	Pyr 1	4
	Pyr 9	2
	Pyr 11	2
	Pyr 15	1
	Pyr 18	1
	Pyr 19	1
	Ramila sp.	3
	Sameodes cancellalis Zeller	5
	Sameodes sp.	1
	Spoladea recurvalis Fabricius	2
	Syllepte fabiusalis Walker	1
Schoenobiinae	*Scirpophaga nivella* Fabricius	4
Wurthiinae	*Niphopyralis aurivilli* Kemmer	1
	Niphopyralis sp.	1
	Pyr 2	2
	Pyr 3	4
	Pyr 4	1
	Pyr 6	3
	Pyr 7	1
	Pyr 10	1
	Pyr 12	1
	Pyr 13	1
	Pyr 14	1
	Pyr 16	2
	Pyr 17	1
Thyrididae	*Canaea sp.*	1
	Herdonia sp.	1
	Opula sp	1
	Picrostomastis inductalis Walker	12
	Rhodoneura citrina Hampson	1
	Striglina sp.	2
	Striglina tibiaria Walker	1
	Telchines vialis Moore	1
	Thy1	1
	Thy2	1
	Thy3	1
	Thy4	1
Tineidae	*Opagona sp.*	1
Tortricoidae		
Olehtreutinae	*Bactra sp.*	1
Tortricinae	*Meridemis furtive* Diakonoff	1
	Meridemis sp.	3
	Schoenotenes pseudurga Diakonoff	1
	Terthreutis sp.	1
	Vellonifer sp.	1
Yponomeutidae	*Plutella xylostella* Linnaeus	1
Total		222

Table 3: Number of species and number of individuals of family collected in lowland tropical forest of Sarawak.

Family	No. of species	No. of individuals
Lecithoceridae	1	4
Oecophoridae	2	11
Pterophoridae	1	1
Psychidae	5	9
Pyralidae	63	163
Thyrididae	12	24
Tineidae	1	1
Tortricoidae	6	8
Yponomeutidae	1	1
Total	92	222

Table 4: Percentages of species and individuals of microlepidoptera collected in lowland tropical forest of Sarawak.

Family	Percentages of species (%)	Percentages of individuals (%)
Lecithoceridae	1.09	1.80
Oecophoridae	2.17	4.95
Pterophoridae	1.09	0.45
Psychidae	5.43	4.05
Pyralidae	68.48	75.97
Thyrididae	13.04	10.81
Tineidae	1.09	0.45
Tortricoidae	6.52	3.60
Yponomeutidae	1.09	0.45
Total	100	100

CONCLUSION

The faunistic composition in three sites showed that Pyralidae is the most diverse and common family of microlepidoptera in lowland tropical forest of Sarawak. A total of 222 species were recorded and this could serve as a basis for further studies of the microlepidoptera in Sarawak.

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